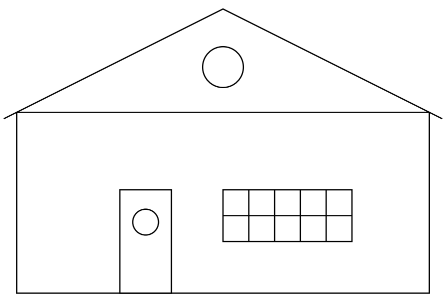
¶ **1.** Angles are used to measure steepness or inclination. For example, carpenters talk of the pitch of a roof to describe it; for example, a 4 in 12 pitch means that a roof raises 4 ft for every 12 feet of horizontal distance.

(a) Which is steeper, a "5 in 12 pitch" roof or a "7 in 14 pitch" roof?

(b) This building has a roof with a 1 in 2 pitch. If the building is 64 feet long, how high is the peak of the roof from the attic floor?



¶ **2.** There is no universal units for measuring steepness in everyday life. For example, if you drive up north on the 5 Freeway, soon after you leave town you will see road signs like this one

The "18%" is a measure of the steepness of the road, but the units are not directly comparable to those used in measuring the steepness of a roof in the previous problem: an 18 in a 100 pitch roof is not equally steeper as an "18% grade" road.

The "grade" units of measure refers to $\dfrac{\text{Rise}}{\text{Run}} \times 100$, so for example if you travel for 1 mile down a highway with a grade of 18% means, then you would have descended 0.18 miles (or 950 feet)

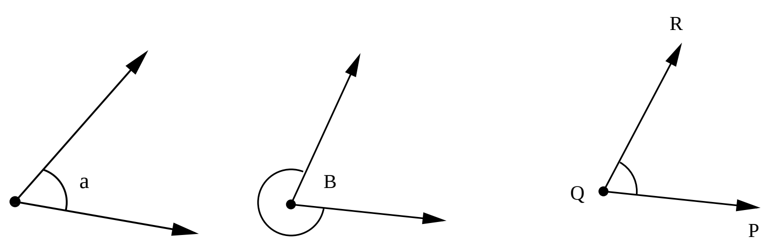
(a) What % grade corresponds to a 1 in 1 pitch?

(b) What % grade corresponds to a 5 in 12 pitch?

(c) Which is steeper, a "18 in 100" pitch roof or a "18% grade" road?

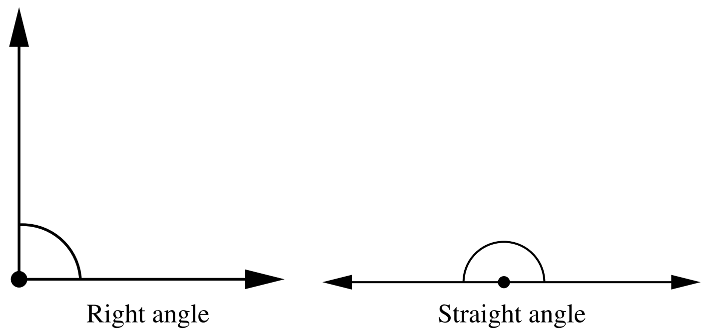
(d) What pitch corresponds to a 6% grade?

¶ 3. In math we measure angles. To do so, we choose a unit, and the express the measure of angles as multiples or fractions of that unit. Two common units are full turns and degrees.
Two rays with issuing from the same point separate the plane into two regions, and we can distinguish the two regions by drawing small arcs. In elementary school, an angle is two rays with the same endpoint with such an arc. The rays are called the sides of the angle, and the endpoint is called the vertex of the angle. The symbol for angle is $\angle$.
Angles are named by drawing and arc and using of the following notations:



Naming the arc $\angle a$ Naming the vertex $\angle B$ Naming the three points $\angle PQR$

¶ **4.** A right angle is that made by two perpendicular rays. If we view the arc that corresponds to a right angle as part of a circle, we see that a right angle is 1/4 of a full turn. Two adjacent right angles then form a 1/2 turn, also called a straight angle.



A more common measure is degree. For this we divide the circle into 360 equal arcs, the angle corresponding to each small arc is 1 degree. Consequently, a straight angle is 180° and a right angle is 90°.

(a) How many degrees are there in a 1/3 full turn?

(b) In a 1/5 of a full turn?

(c) How many degrees are there in a 1/6 of a right angle?

¶ **5.** In an analog clock,

(a) How many degrees does the hour hand move per hour?

(b) How many degrees does the hour hand move per 1/4 hour?

(c) What is the angle between the two hands at at 4:00?

(d) What is the angle between the hands at at 5:10?

¶ **6.** (a) The Moon completes a full turn around the Earth in 28 days. Through which angle does the Moon appear to move per day?

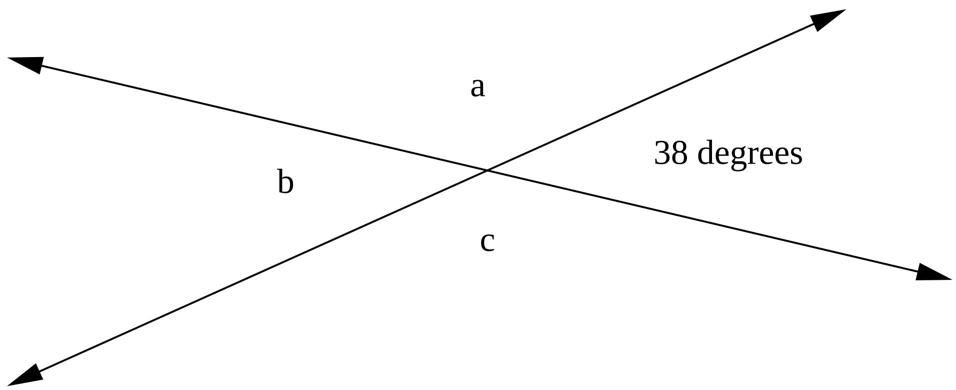
(b) The Earth travels around the Sun in about 365 days. What is the angle that it covers per day? Per month? Per week?

(c) The Sun is about 10^8 miles away from the Earth. Approximately, how many miles does the earth travel around the sun in a whole year?

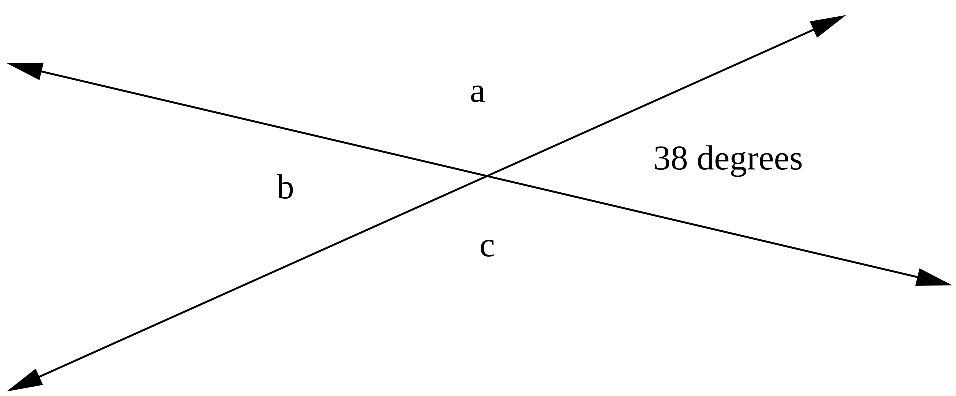
(d) What is the approximate speed (in miles/hour) of the Earth as it travels around the sun?

¶ **7.** There are some basic facts about angles that we need to review. First note that adjacent angles add up. Two angles that add to a straight angle are called supplementary. Two angles that add to a straight angle are called complementary.

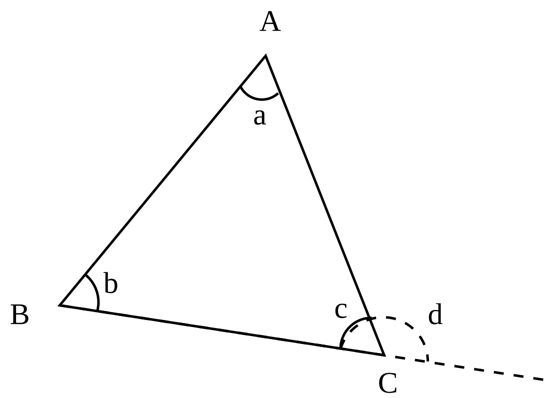
(a) Find the measure of the angles a, b and c in the figure



(b) This illustrates an important point. Two lines intersecting at a point determine 4 angles and these are equal in pairs: opposite angles are equal. In the figure, angles $\angle a$ and $\angle c$ are opposite, and $\angle b$ and $\angle d$ are opposite as well.



¶ 8. Another fundamental geometric fact regarding angles concerns the angles between consecutive sides of geometric figures, like triangles and other polygons.
Two consecutive sides of a triangle determine an interior angle, that which has its arc in the same side as the figure. An exterior angle is an angle formed by one side of the triangle and the straight extension of the other side. So a triangle has three pairs of exterior angles. These concepts apply to other polygons in the obvious way.



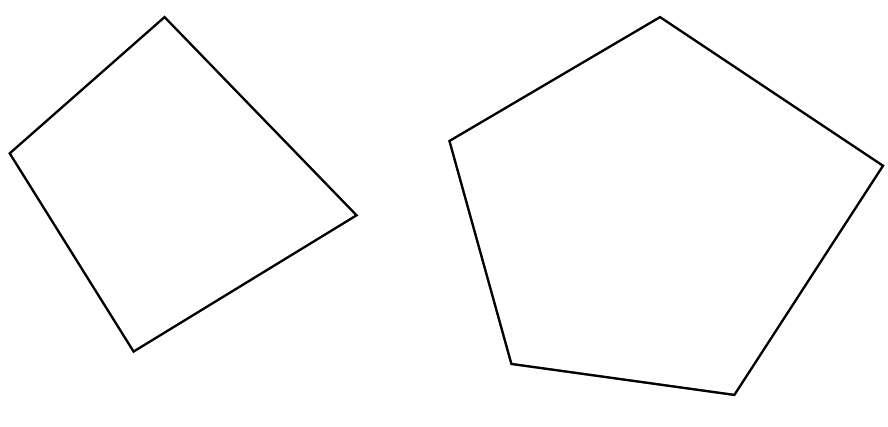
In the triangle ABC, the angles a, b, and c are the interior angles. Angle d is an exterior angle.

Theorem. *In any triangle, the sum of the three interior angles is* 180 *degrees*

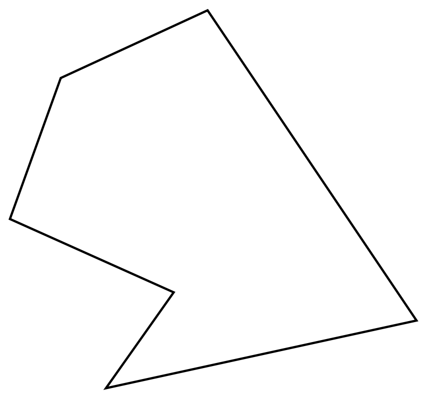
¶ 9. This Theorem allows you to compute angles of many other figures.

(a) What is the sum of all the exterior angles of a triangle?

(b) Find the sum of all the interior angles of the following polygons.



(c) What is the sum of all the interior angles of this polygon?



(d) Can you generalize the calculation in (b) and find the sum of all the interior angles of a polygon with N sides?